Monitoring Landscape Processes with MODIS data

Page Spencer

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With a lot of help from our friends at USGS/EROS

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SWAN
Southwest Alaska Network

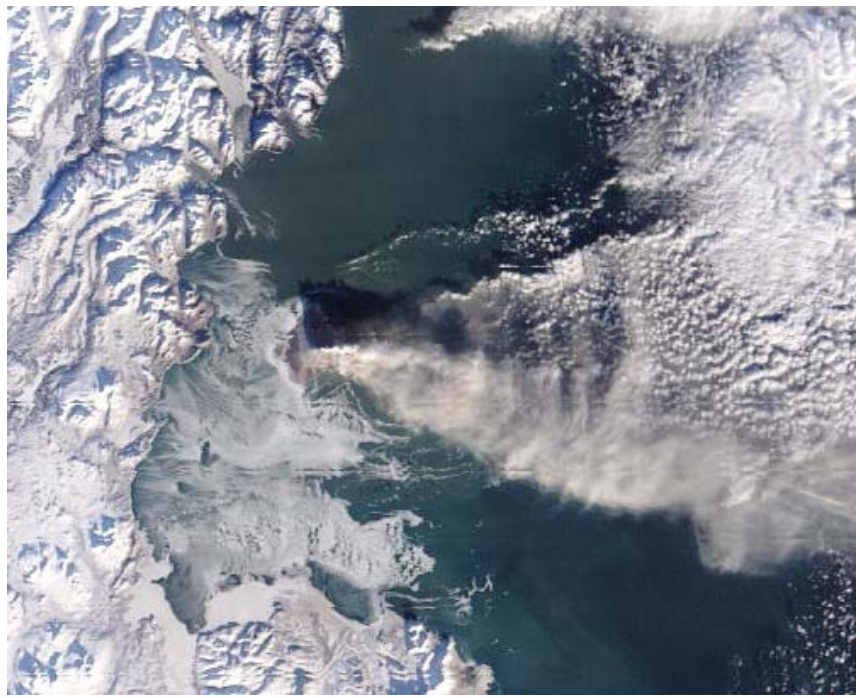
How are **landscape** scale **processes** occurring or changing in space & across time?

Metrics of Interest:

- **Snow seasons**
- **Lake ice seasons**
- **Growing seasons**
- **Unique stochastic events:**
  - **volcanoes, fog, fires, storms**

Why these metrics?

- Synthesize climate on landscape
- Matter to vegetation communities
- Directly impact resident and migratory wildlife, fish, birds
- Permafrost, fire regime, glaciers, exotics
- Impact human activities:
  - Economic
  - Recreational
- Records unusual and sporadic events



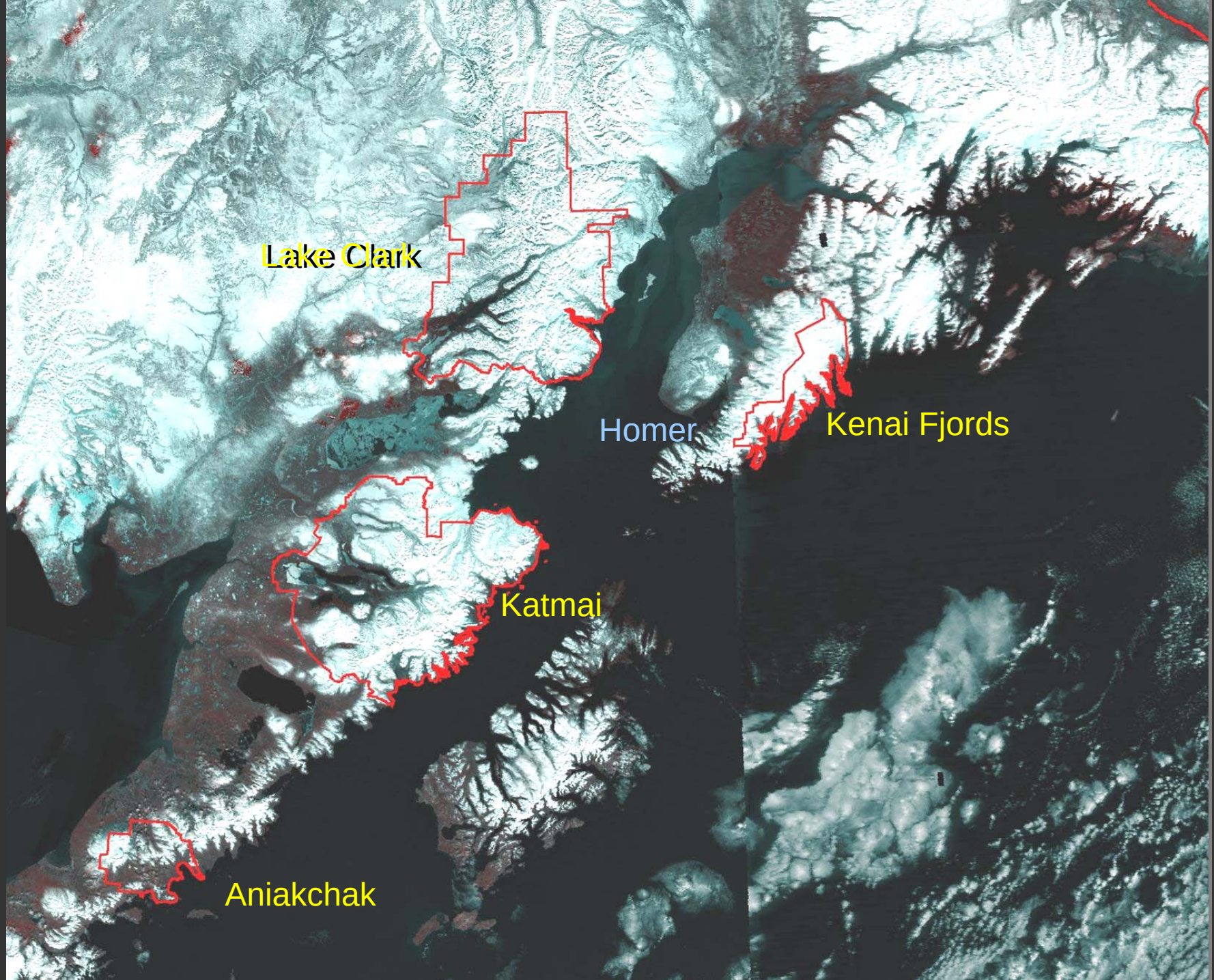
Augustine, Feb 2, 2006

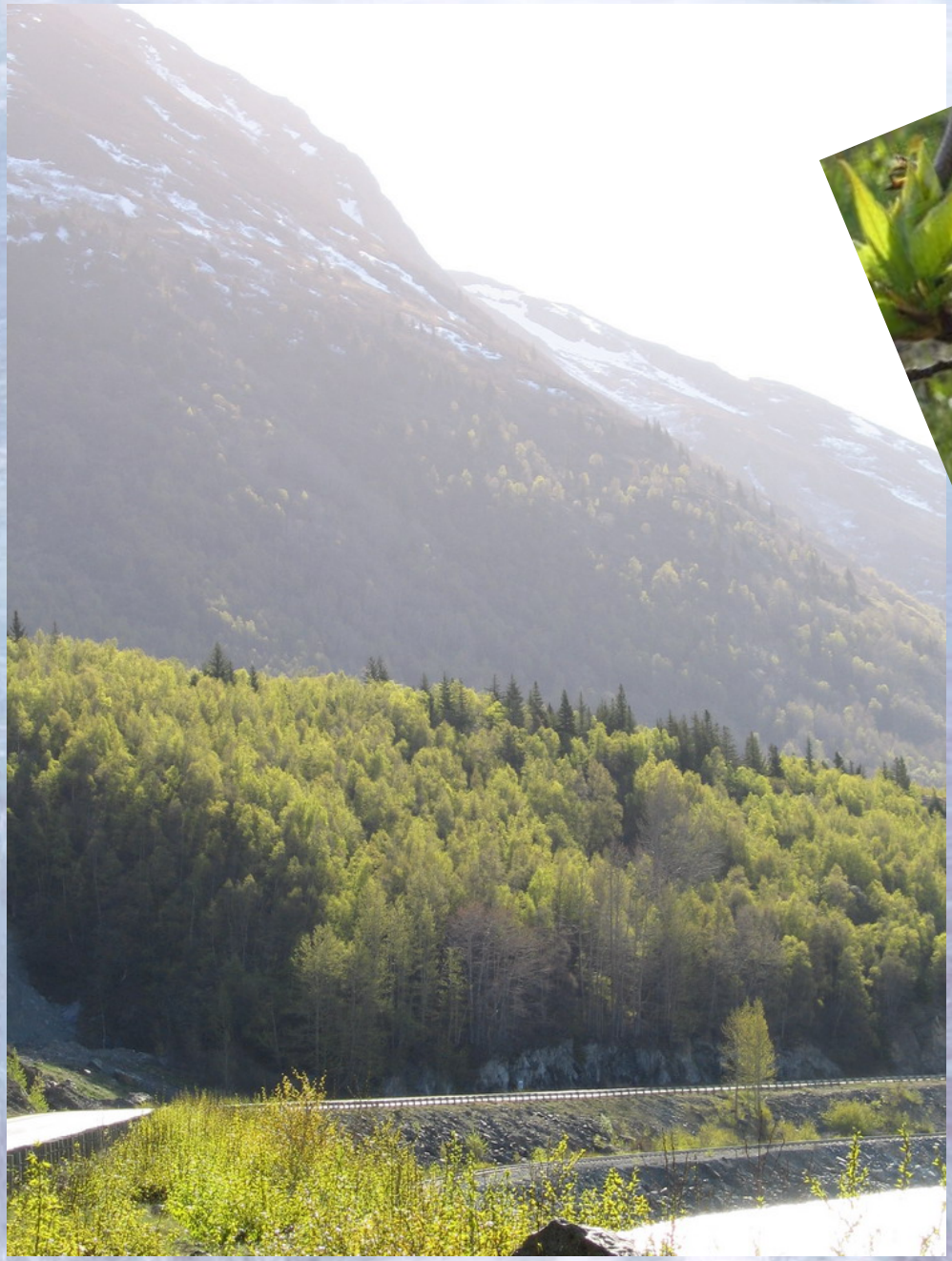
MODIS

Moderate Resolution Imaging Spectrometer

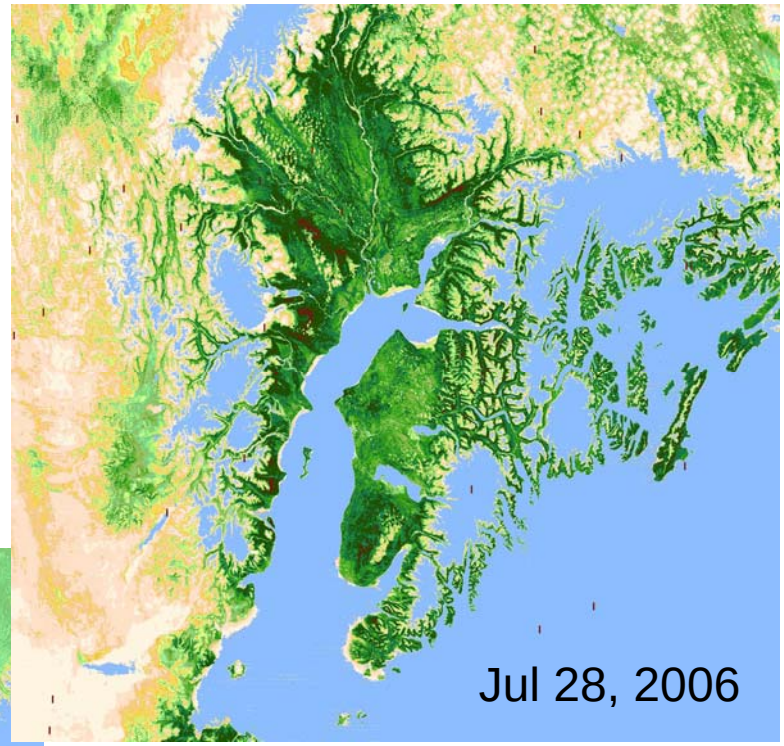
- Moderate spatial resolution (250-1000m)
- High temporal resolution (2Xdaily)
- 36 spectral bands for various applications
- Many standard products: land & sea temp, snow cover, greeness, infra-red & natural color images,albedo, cloud cover
- Many worldwide apps (arctic sea ice cover, el nino, drought)

Best for regional applications with short-lived or seasonal phenomena


Lake Clark
Homer
Kenai Fjords
Katmai
Aniakchak



Growing season metrics:
Start, end, length, production



Jul 28, 2006

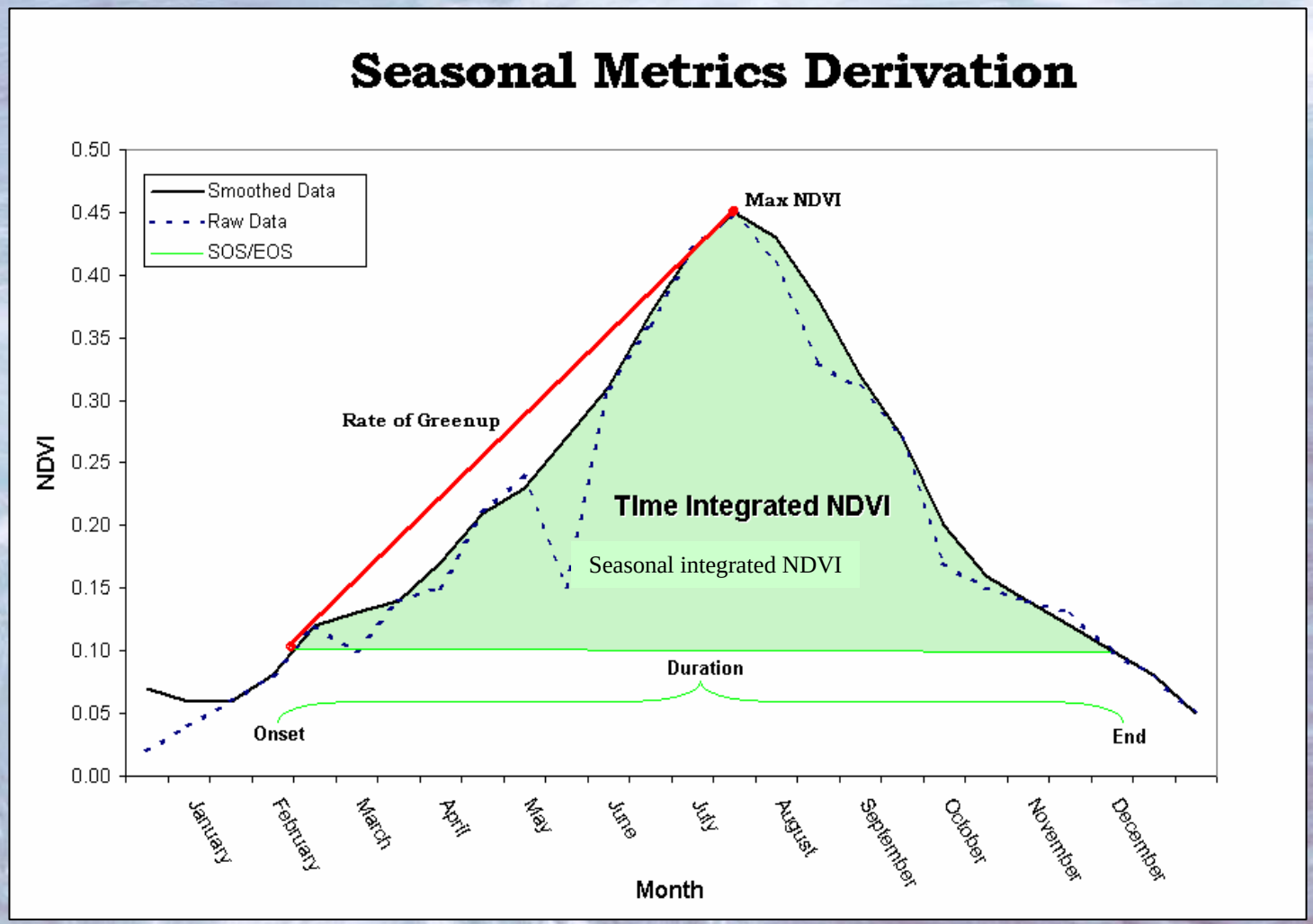
Sept 30, 2006

Sept 13, 2006

Trees observed turning in Anch

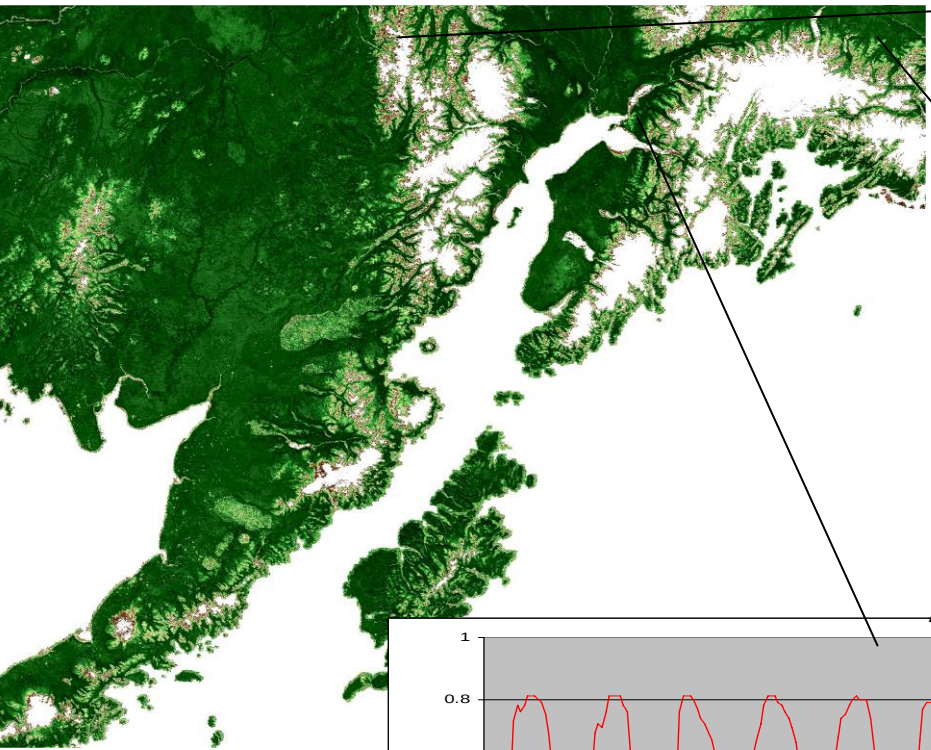
NDVI-measure of vegetation greeness or production

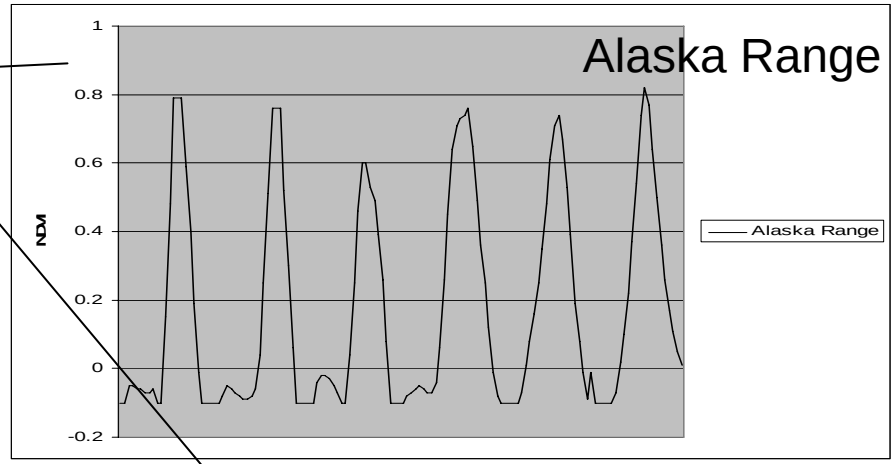
Phenological Metrics from Annual Vegetation Index (VI) Cycle

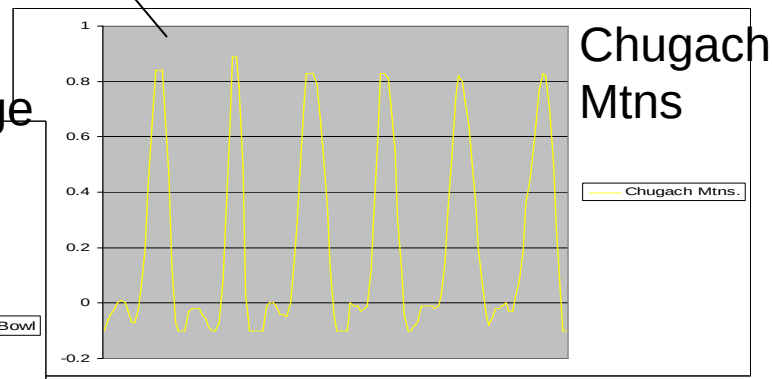


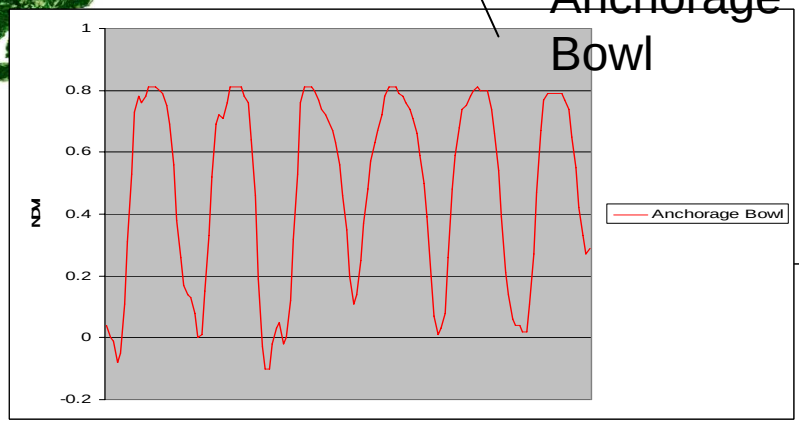
Reed et al. 2004

Temporal Vegetation Index Curves for 2000-2005





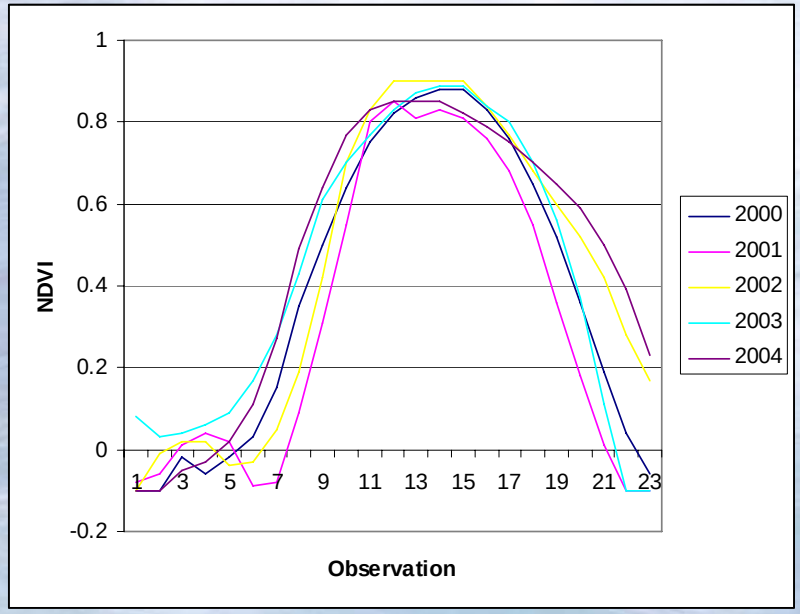




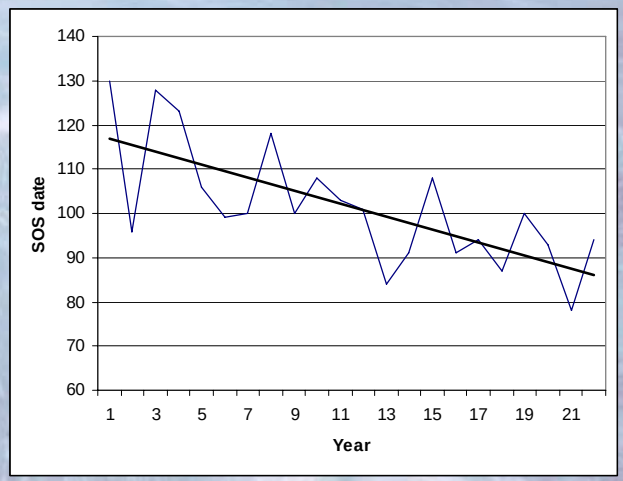
These curves illustrate differences in growing season length between different regions and between years.

B. Reed, 2007

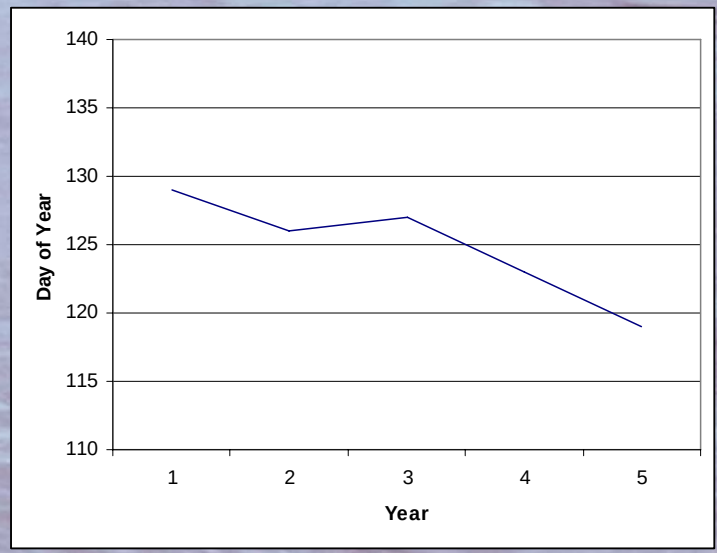
Reed et al, 2006



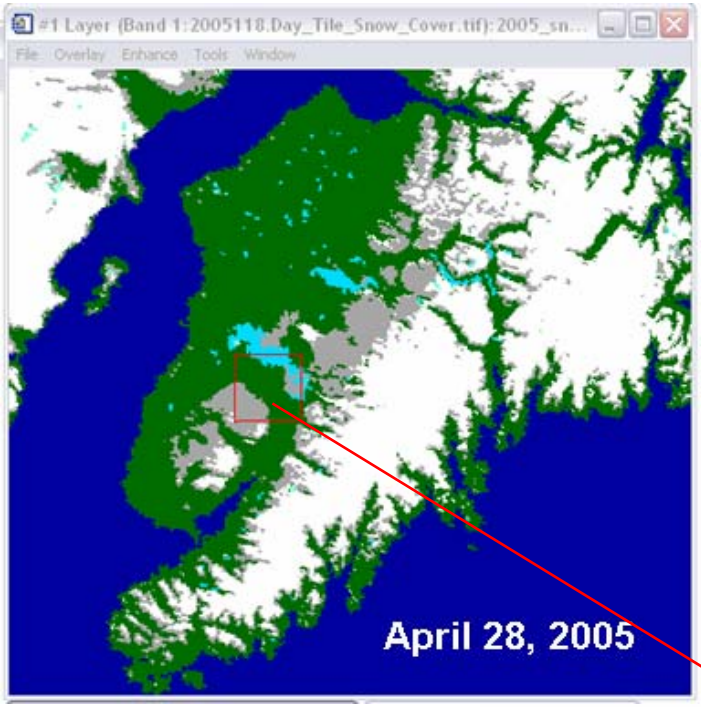
Annual vegetation index temporal curves from 2000-2004.



Time of start of season for 1982-2003 for a pixel in SWAN region—from AVHRR data

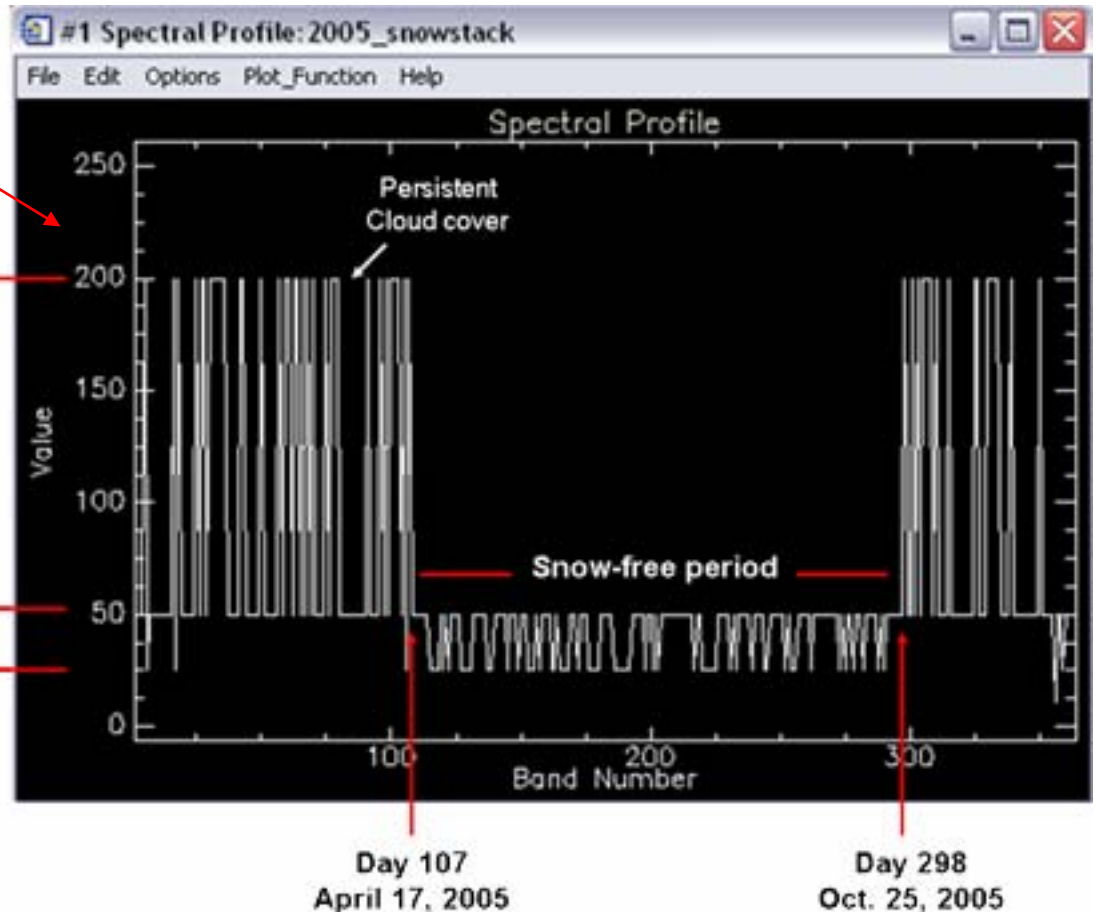


Start of season day for a pixel in SWAN for years 1 (2000) through 5 (2004)—from MODIS data

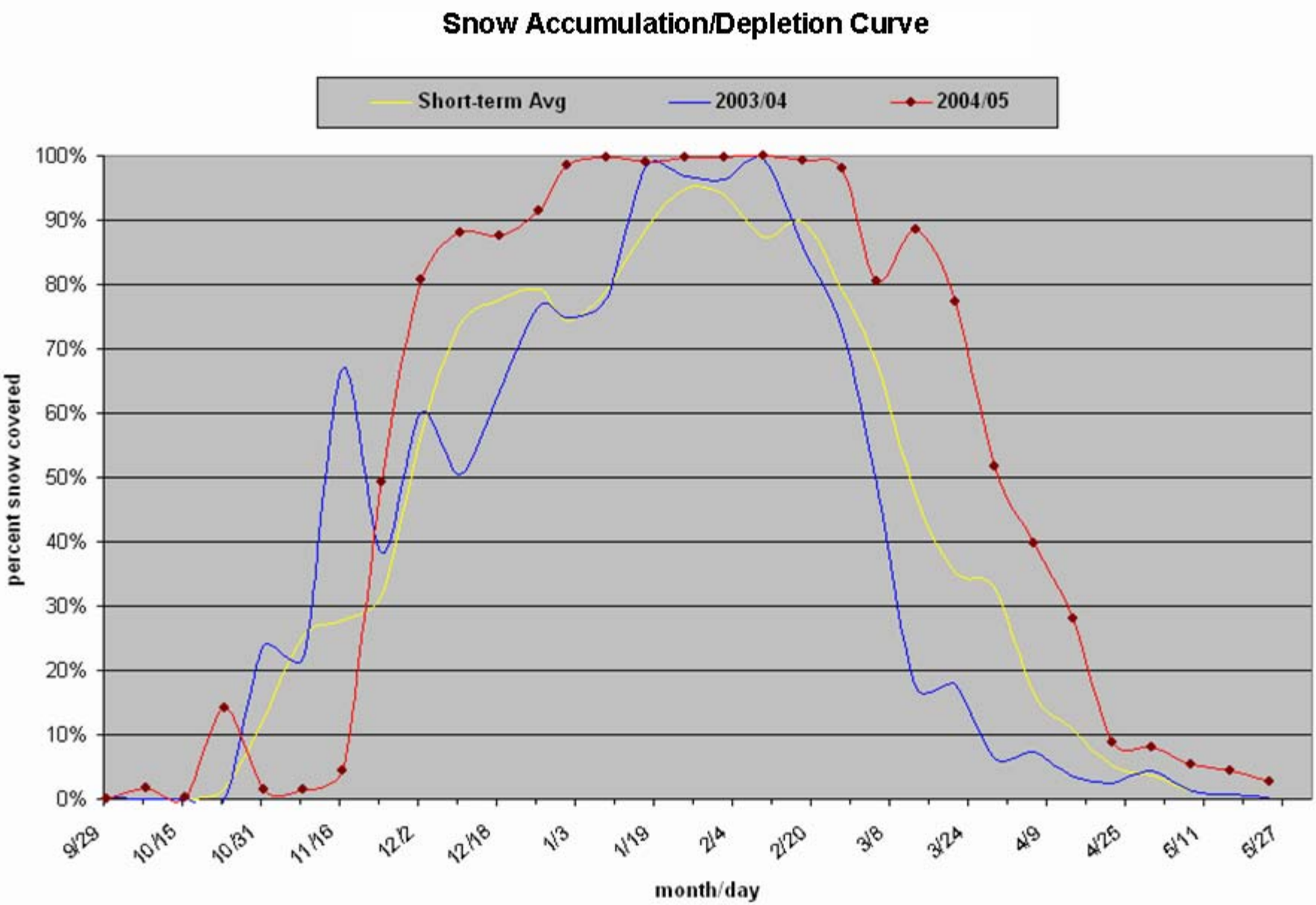


The snowseason profile for a pixel in the Nikolai Creek area south of Tustumena.

Band numbers represent the day of year and y-axis values represent snow cover pixel classifications.

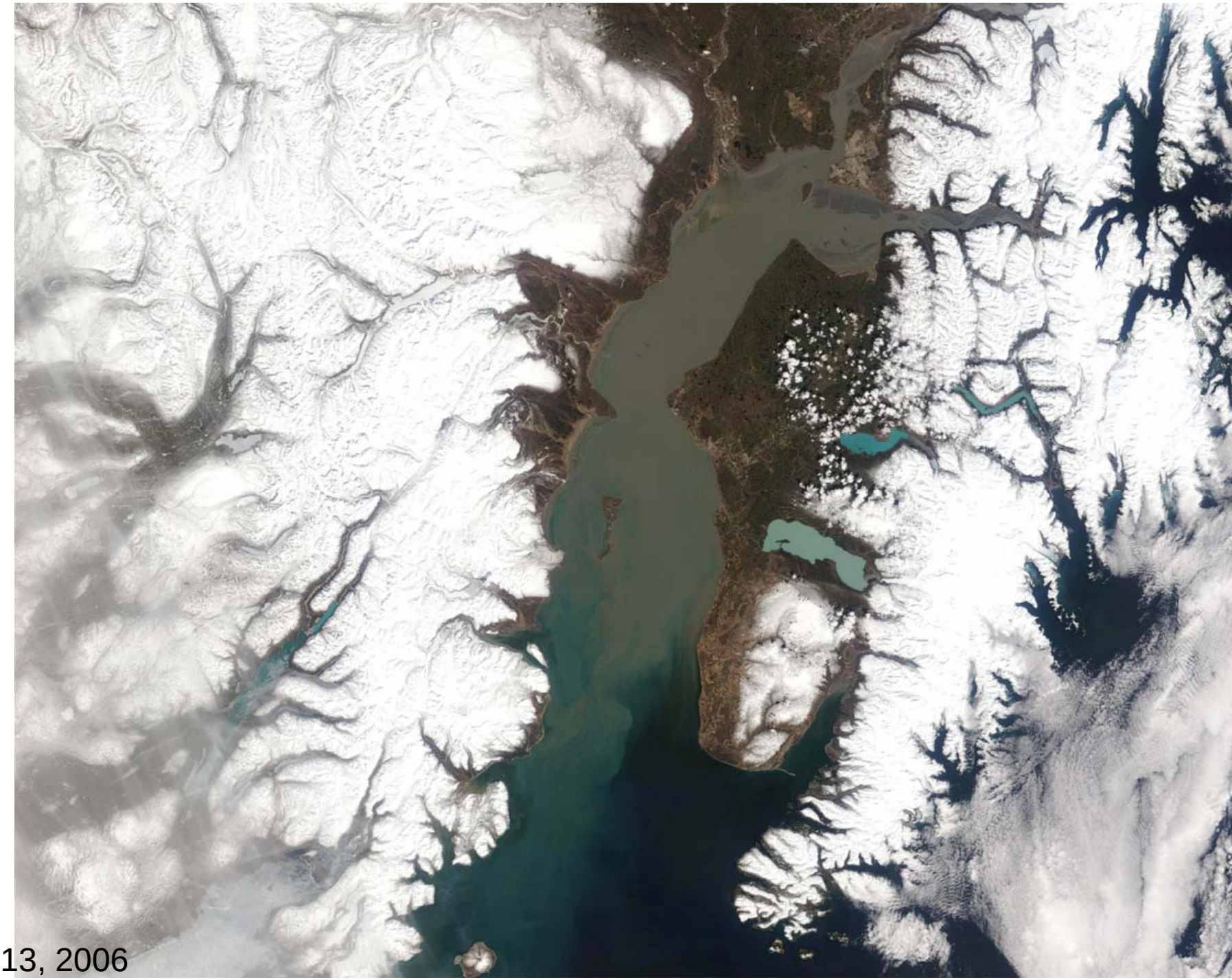


M. Budde, 2007

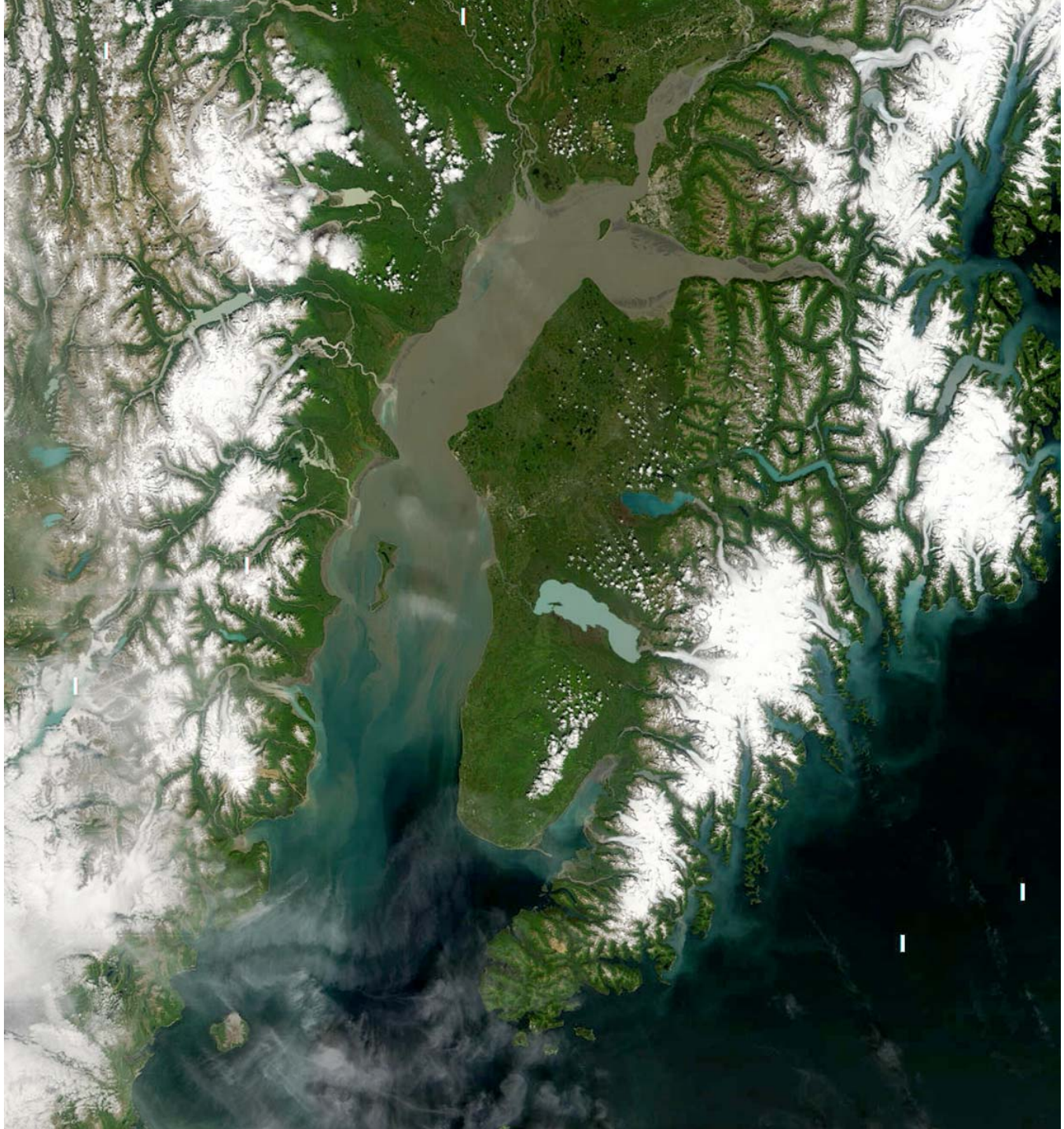

Snow Accumulation/Depletion Curve
Short-term Avg
2003/04
2004/05
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
percent snow covered
9/29
10/15
10/31
11/16
12/2
12/18
1/3
1/19
2/4
2/20
3/8
3/24
4/9
4/25
5/11
5/27
month/day

M. Budde, 2006

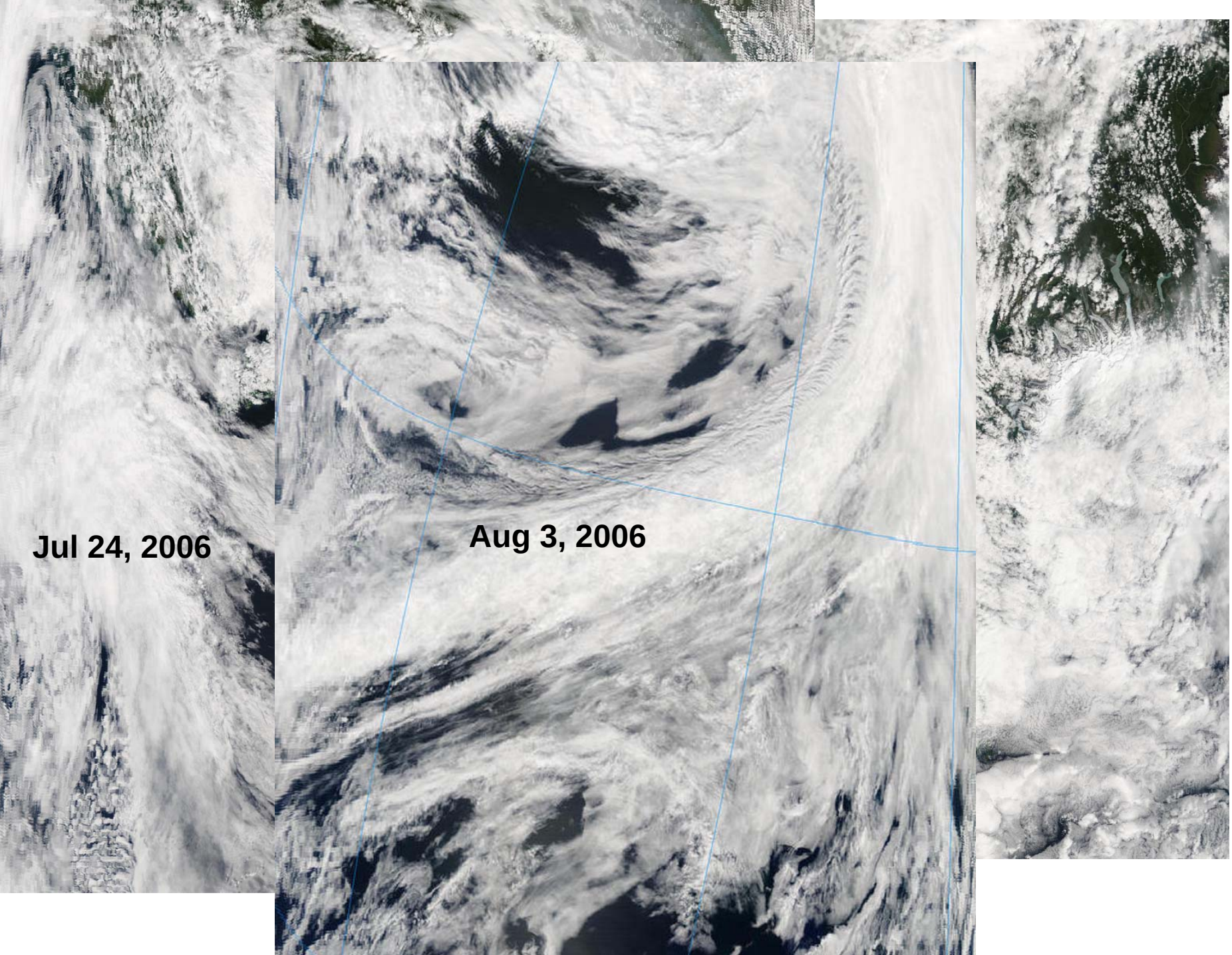
Mar 9, 2006



May 13, 2006

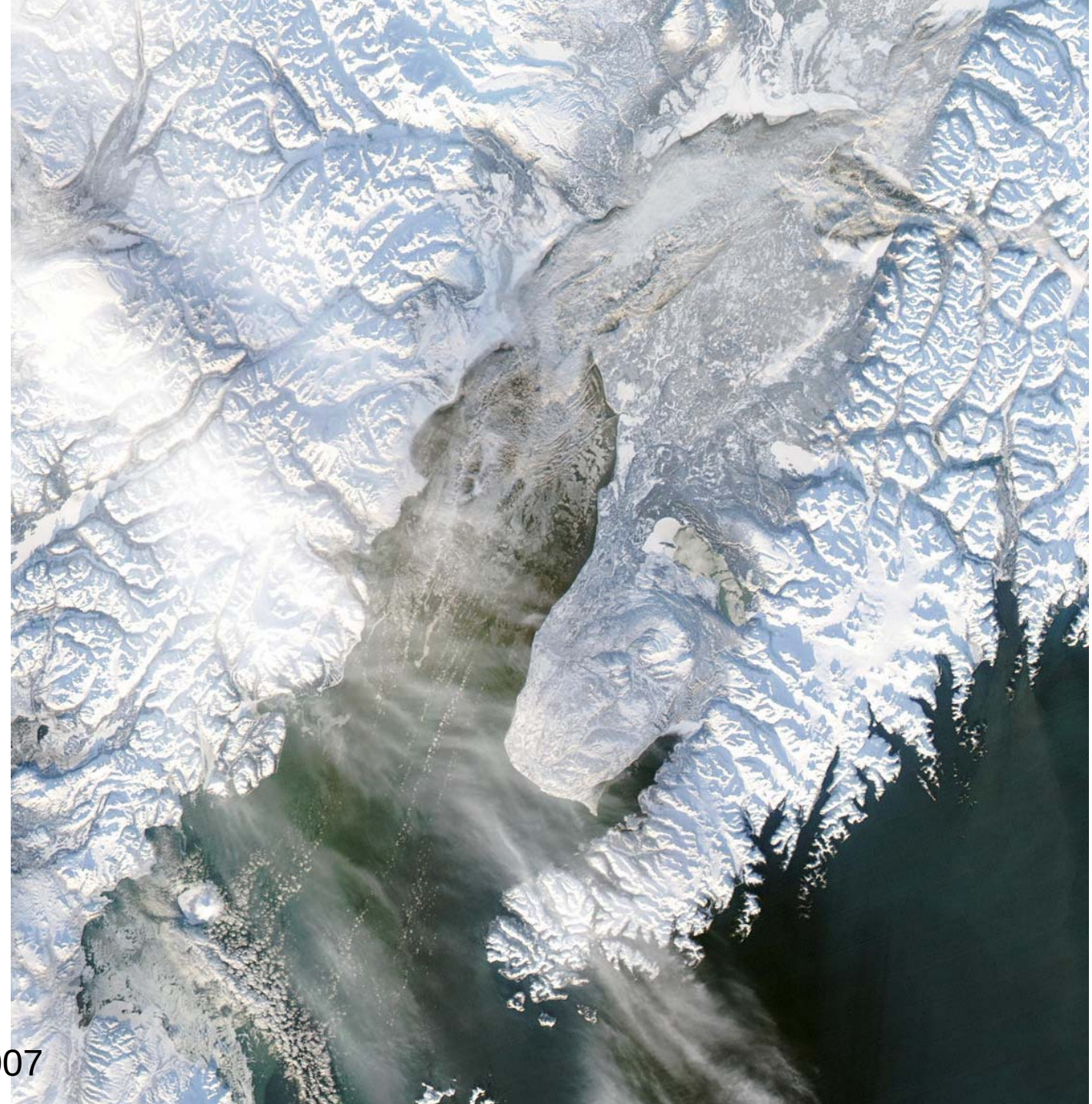


Jul 28, 2006

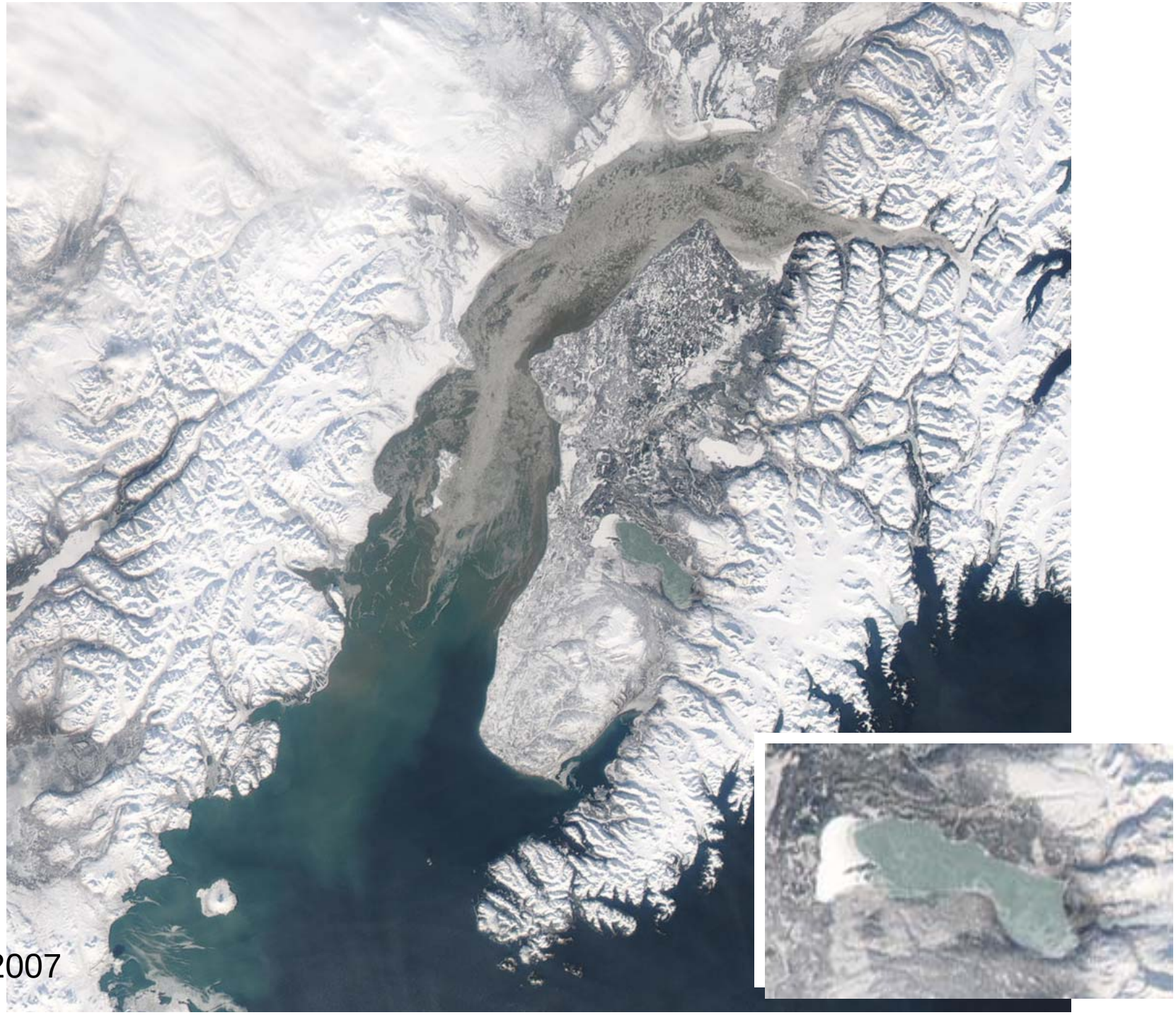

Jul 24, 2006
Aug 3, 2006


Sept 13, 2006

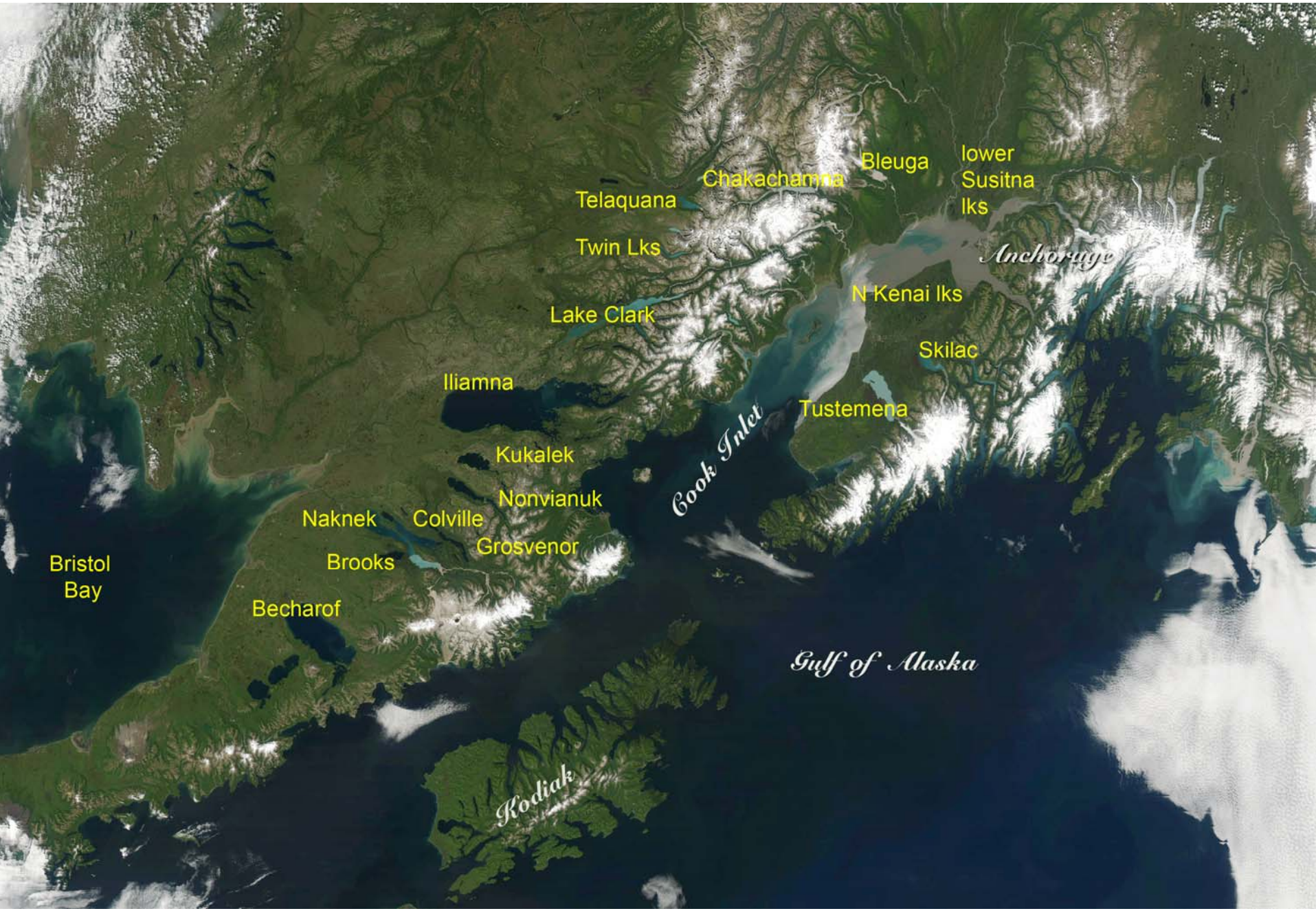

Oct 31, 2006

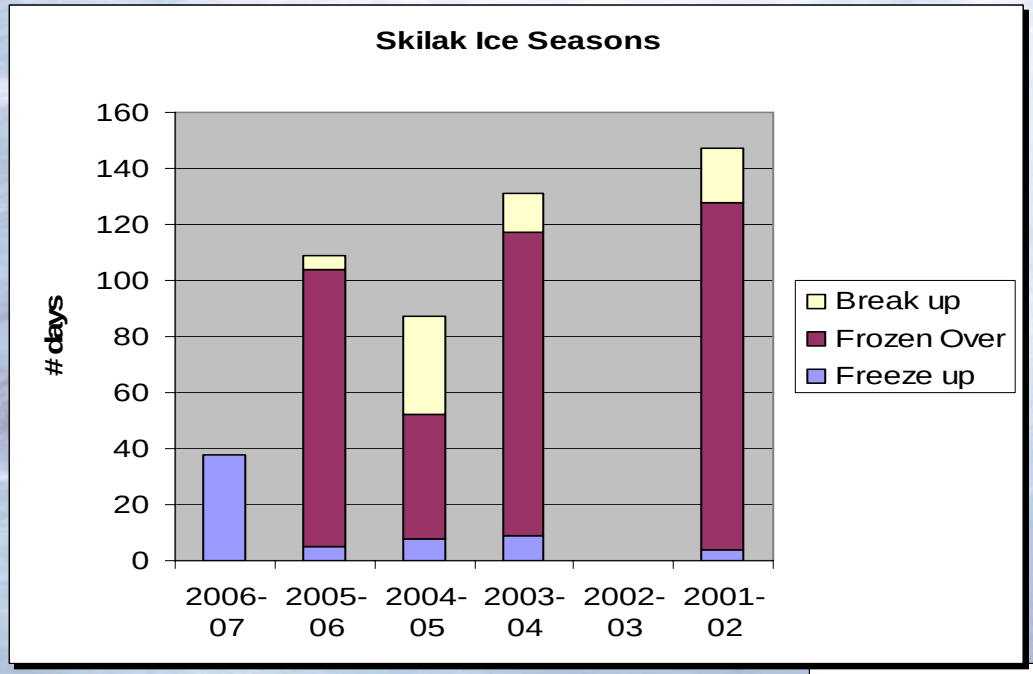


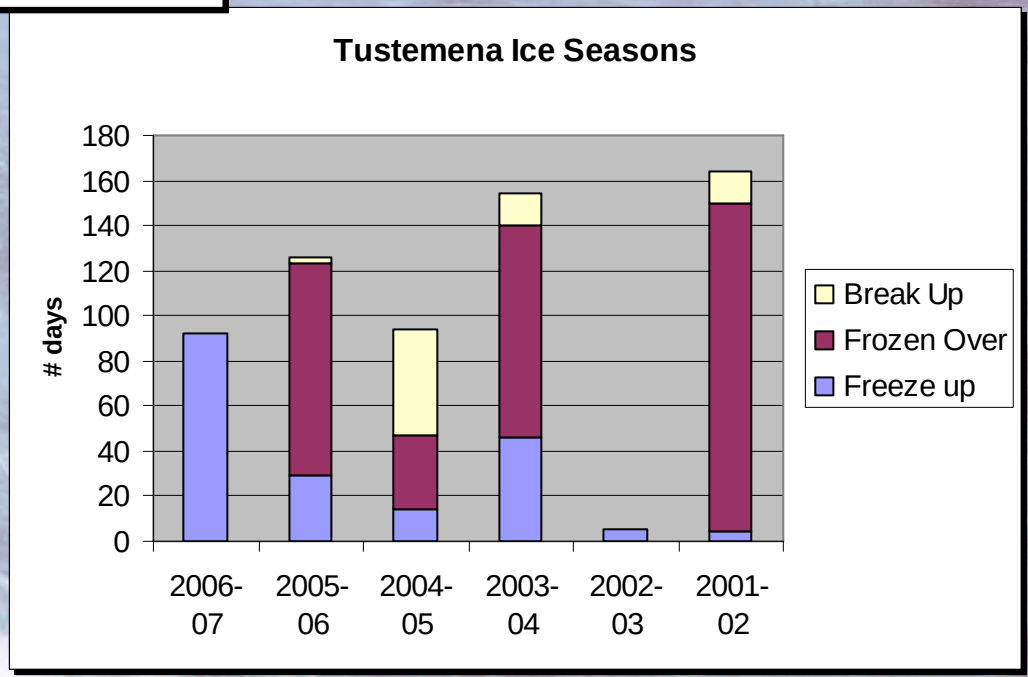
Jan 9, 2007



Feb 26, 2007


Bleuga
lower
Susitna
lks
Chakachamna
Telaquana
Twin Lks
Anchorage
N Kenai lks
Lake Clark
Skilac
Iliamna
Tustemena
Cook Inlet
Kukalek
Nonvianuk
Naknek
Colville
Grosvenor
Brooks
Bristol
Bay
Becharof
Gulf of Alaska
Kodiak


Skilak Ice Seasons
160
140
120
100
80
60
40
20
0
days
2006-07
2005-06
2004-05
2003-04
2002-03
2001-02
Break up
Frozen Over
Freeze up

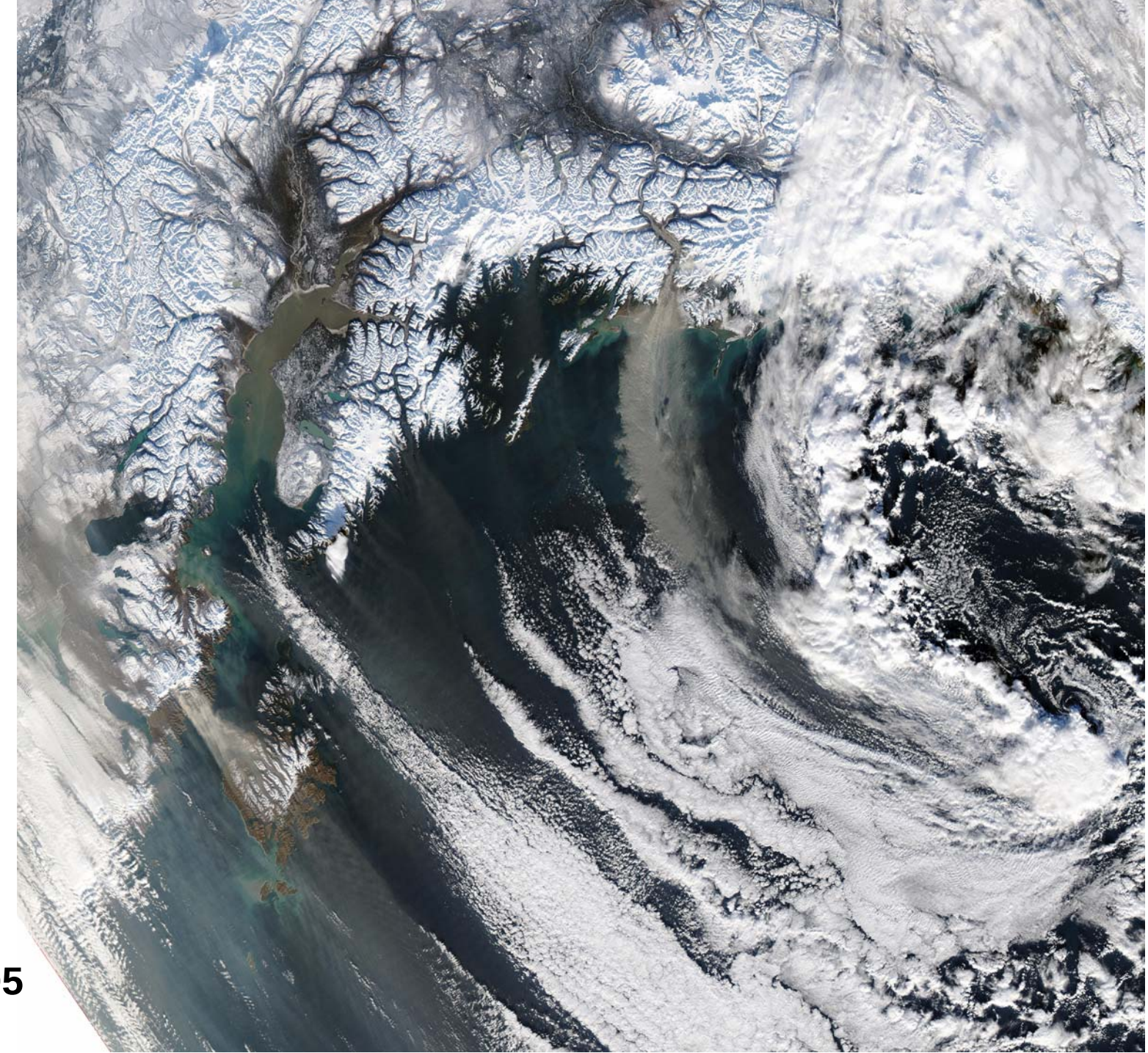

Tustemena Ice Seasons
180
160
140
120
100
80
60
40
20
0
days
2006-07
2005-06
2004-05
2003-04
2002-03
2001-02
Break Up
Frozen Over
Freeze up

Things we've learned to date:

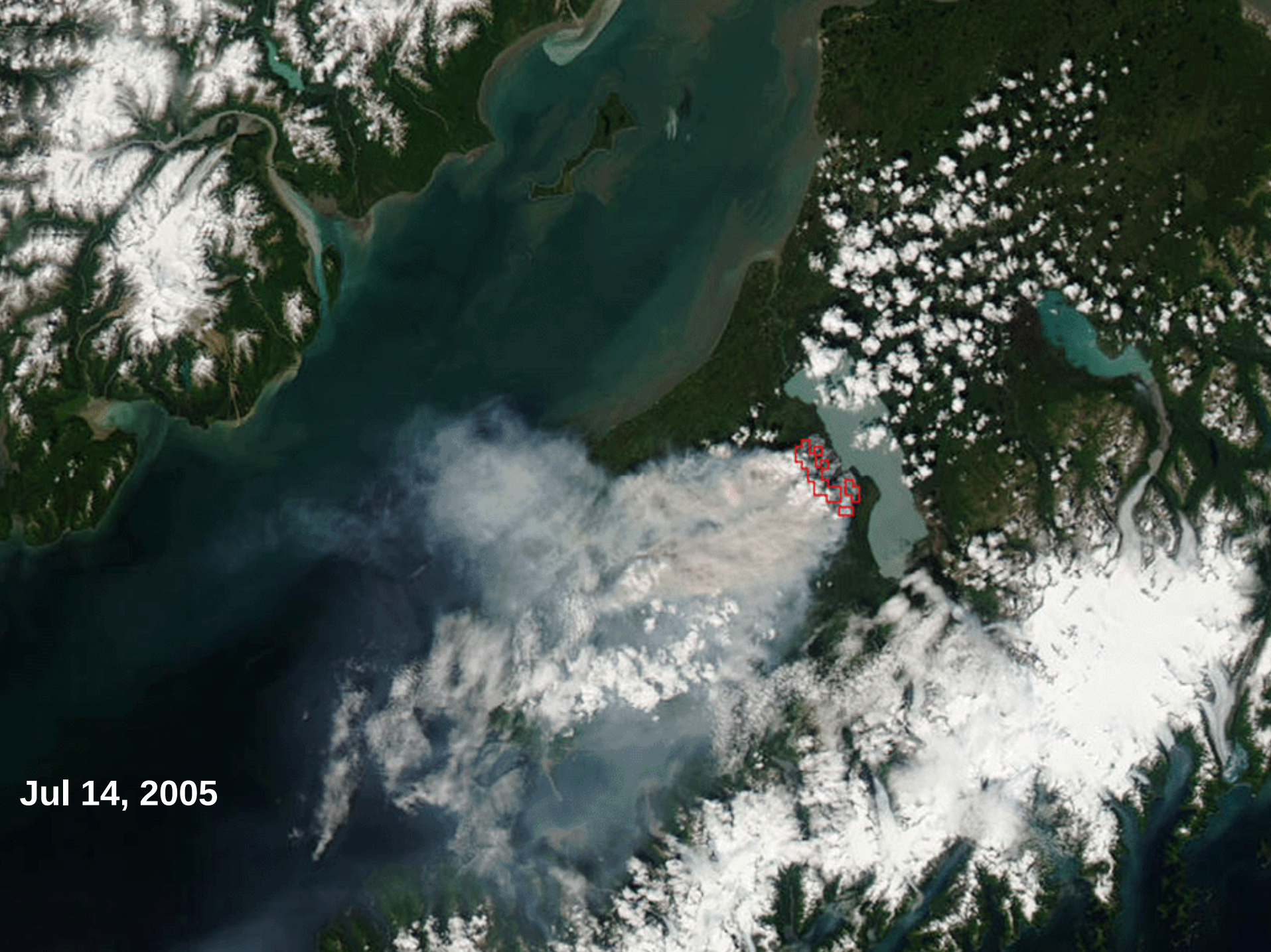
- **Trend to earlier spring-25yrs**
- **Spring starts earlier than we can see**
- **Lake ice comes and goes-often several times a winter**
- **Interpreting ice is harder than one might think—at least 17 terms for ice surfaces**
- **This country is at the transition zone, being directly impacted by climate changes**
- **Amazing things are happening -- every day**
- **Winter matters**

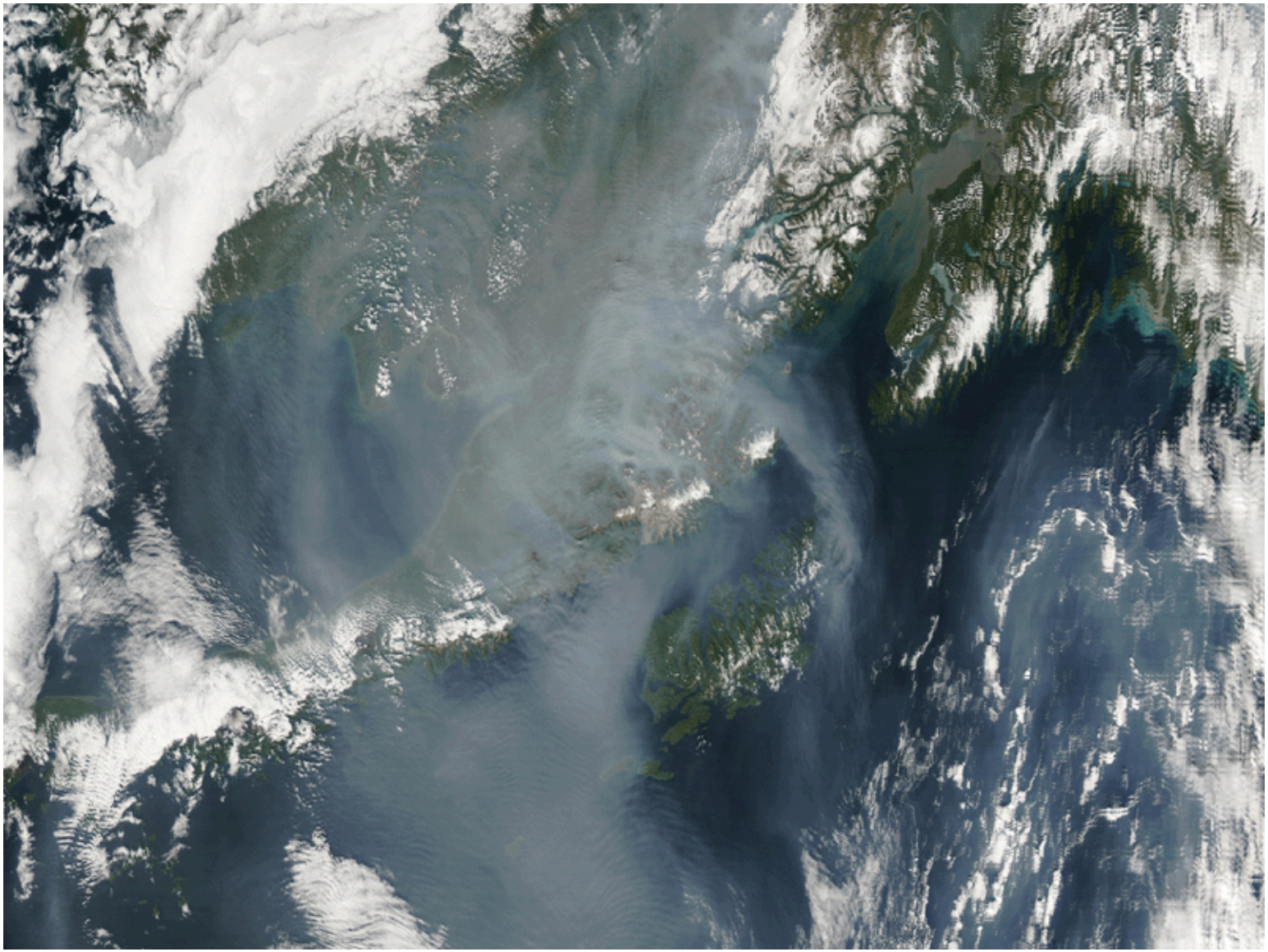
Status:

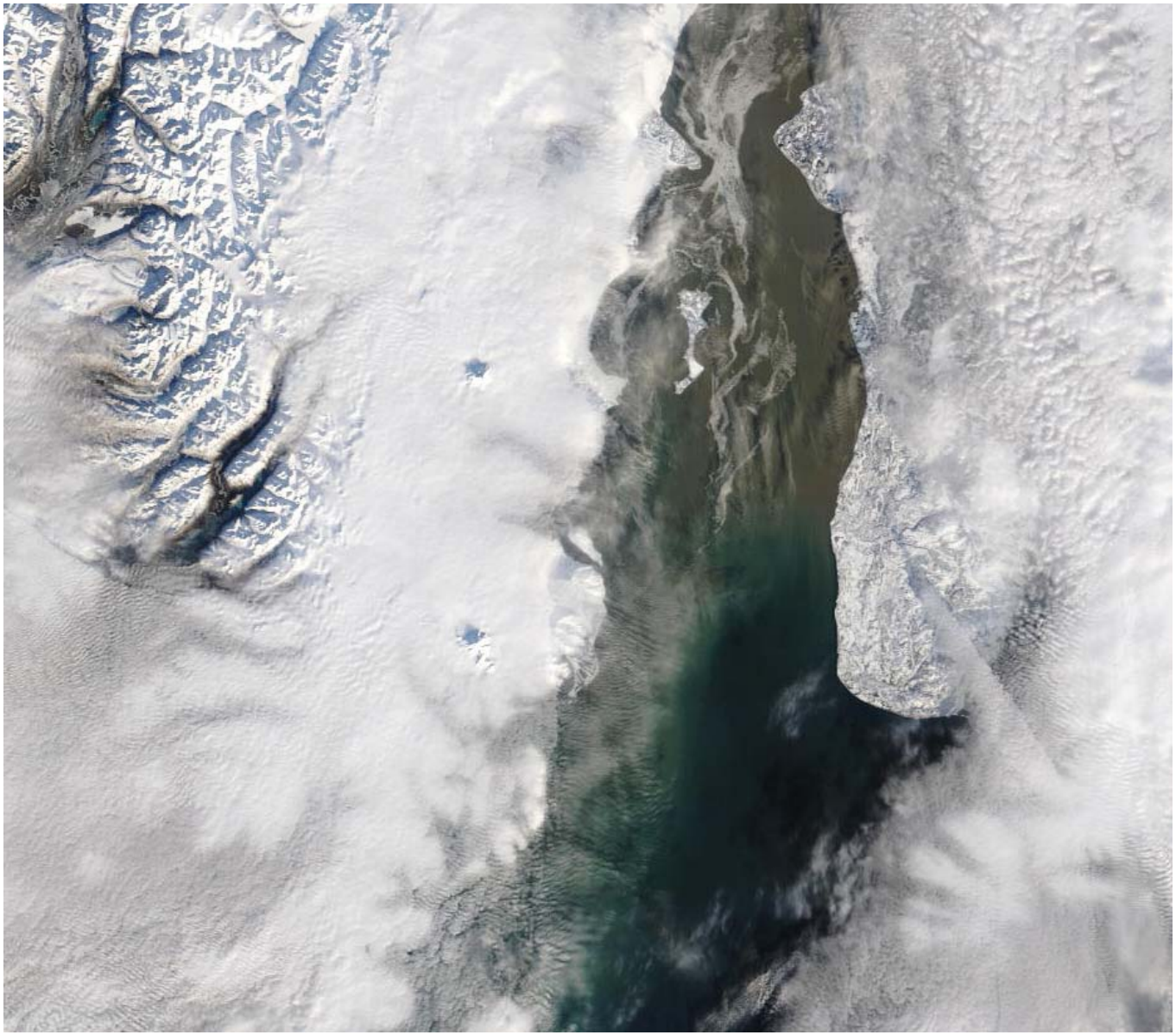
- Cover many lakes in network—dynamics in other areas
- Long term trends
  - Climatic data
  - Historical datasets
- Protocol is done (for now…)



Nov 5, 2005

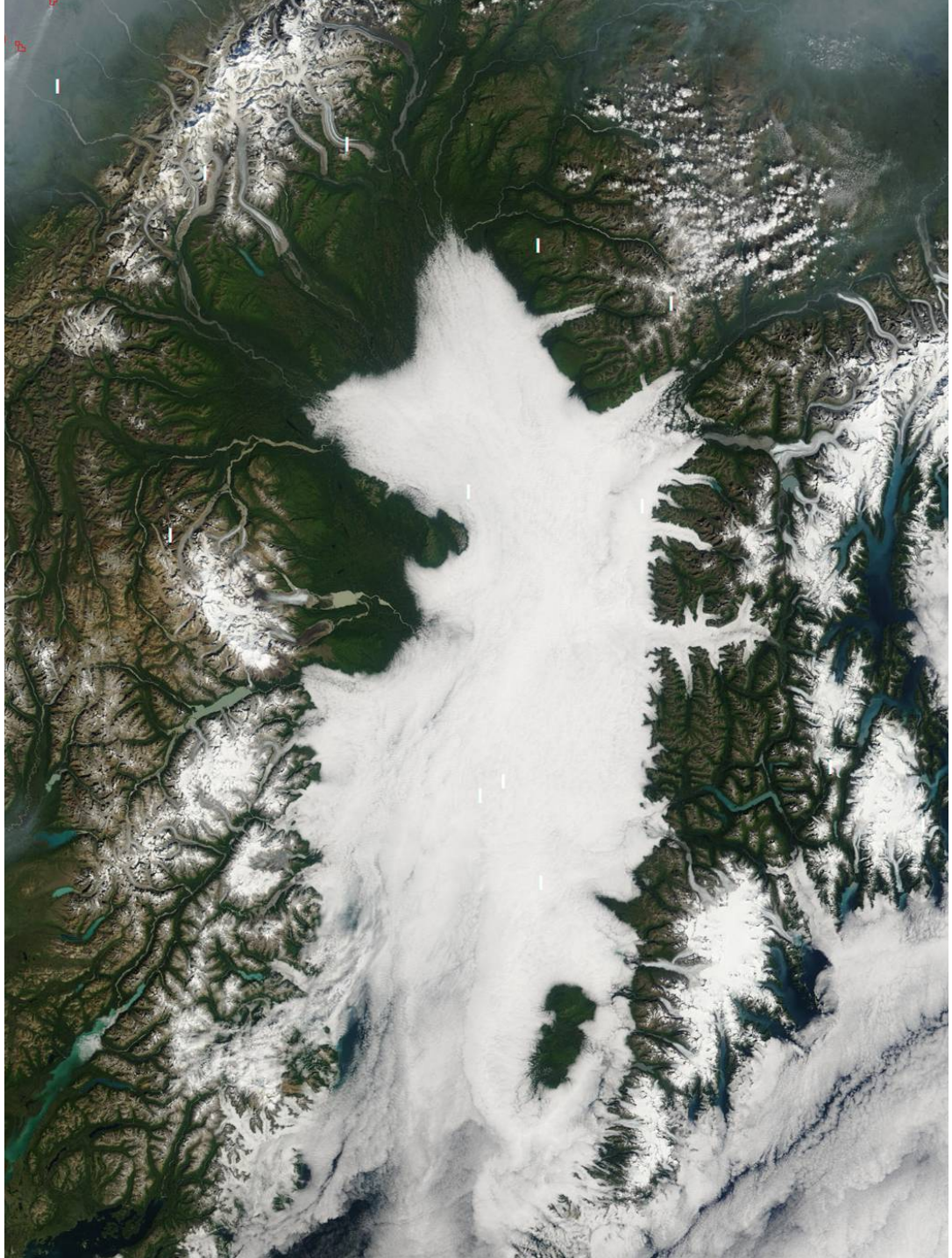

Jul 14, 2005





Redoubt and Iliamna volcanoes in the fog

Feb, 16, 2007



Cook Inlet during the Pleistocene

August 14, 2005

http://rapidfire.sci.gsfc.nasa.gov/

- Click Real-time
- Select date by julian day (see calendar)
- Scroll through thumbnails for both satellites; Alaska is usually in the 20-23 hrs UTC
- Ck out the

Gallery for really nice images